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and secondly, by division of the glosso-pharyngeal nerves. After excision of the whole or a part of a papilla foliata of the rabbit, the area corresponding to the part removed becomes slightly depressed, and between the 5th and 8th day is revested with pavement epithelium. Later, from the 16th to the 20th day, a few small hemispherical elevations make their appearance, and these subsequently increase in size and number. During this period also many of the injured gland ducts undergo repair and become continuous with the free surface of the epithelium. Other ducts are found in the submucosa with their external opening closed, and greatly dilated by retained glandular secretion. The nuclei of the cells of the newly formed epithelium, both of the papilla and ducts, exhibit varied karyokinetic phases. Within the secondary papillary processes of the elevations above referred to, taste-bulbs, lying partly in the mucosa (and in process of formation), first make their appearance. Ten days after the complete excision of a papilla circumvallata of the dog, the area of removal is reclothed with epithelium, and the ducts communicate with the free surface. Twenty to thirty days later, a slightly raised and more or less rounded elevation of the mucosa is discernible, analogous to the reproduced elevations of the foliate organ. At the 40th day (in a single instance only) a few taste-bulbs, situated at the lateral margin of an elevation, were seen. The outer enclosing wall of the trench is not reproduced, the newly formed papilla having the characters of the fungiform type. Following section of the glosso-pharyngeals, the papillae are changed but slightly, but the taste-bulbs begin to degenerate within 23 hours. The taste-cells are first destroyed, disappearing completely by the 5th day; the supporting cells soon after undergo atrophy, and by the 28th day no bulbs are visible. At the 76th day after the division of the nerves, bulbs, in various stages of formation, were seen; but by the 209th day their development was still incomplete. Griffini rejects the theory of direct continuity between nerve-fibres and epithelial cells. He asserts that reproduction of the papillae after their partial or complete removal always takes place. The reproduction of the taste-bulbs, following the removal of a papilla or after section of the glosso-pharyngeal nerve, is effected in the following way: The axis cylinders of the divided nucleated nerve-fibres are regenerated and penetrate the epithelium; active proliferation of the adjacent epithelial cells then occurs, the latter arranging themselves around the interepithelial nerve-fibrils and forming the supporting cells of the bulbs. This research of Griffini, although still incomplete, is a valuable contribution, not only to our knowledge of the taste organs, but also from its bearing upon certain histogenetic and morphological questions. The results attained by him, respecting the origin of the taste-bulbs, are in the main very different from those reached by such observers as Ranyier, v. Vintschgau and Hönigschmied. Griffini has likewise made a similar experimental study of the organ of smell, the motorial end-plate of the muscle-fibre, and the retina of the lower animals, the results of which have not yet, I believe, been published.

F. TUCKERMAN.

Eine Vorrichtung zur Farbenmischung, zur Diagnose der Farbenblindheit und zur Untersuchung der Contrasterscheinungen. E. HERING.
Pflüger's Archiv, Vol. 42, p. 119.

This plan of Hering's for color experiments has the merit of great simplicity. A dark room is provided with a rectangular hole in

a window-shutter in which two frames, which can be filled with different colored glasses, move up and down. The frames are only three-sided, so that the adjacent edges of the pieces of glass may be exactly contiguous. If one frame contains blue glass and the other the complementary yellow, a sheet of paper thus lighted up will appear white. It is, of course, necessary that a line drawn from any point of the paper to every point of the glass should, when produced, strike the evenly illuminated sky; to this end the window must face the north, or else the room can only be used on a cloudy day. Since exactly complementary colored glasses are not easily to be obtained, it will usually be necessary to take three colors to make white light; thus if a given blue and yellow make a greenish white, then half of one frame (which is twice as long as the opening) should be fitted with red glass, and enough of the red should be shoved in to make the paper exactly white. An exact white cannot of course be distinguished from a pale color unless part of the paper is lighted up by white light from another opening and protected from the colored rays. To get the blackest possible background, the paper may be suspended across a larger hole which looks into a black-lined box.

To test for color-blindness, a rod is put up at such a distance from the window that (if the glasses are red and white) the red and the subjectively green shadows are side by side on a paper just big enough to receive them. By cutting off some of the white light by means of a pasteboard slide, the two shadows are made of the same degree of brightness, and to any one who is completely red-blind they will look exactly alike,—it makes no difference what color he pronounces them to be. The copper-red glass of commerce will usually need to have a little blue mixed with it to produce the color which he is completely blind to.

The advantage which Hering claims for this plan over that of rotating disks, aside from its simplicity, is the greater constancy of the colors that are produced; paper varies more in color than glass, and its color changes more with different degrees of illumination. The plan is particularly well adapted to experiments in contrast. The subjective color is extremely vivid and beautiful, sometimes even surpassing the objective color. The chief objection to Hering's view that simultaneous contrast is a physiological effect and not a mere illusion of the judgment, is that the contrast is not greater with a greater intensity of the inducing field. But Hering says that with this arrangement the contrast *is* greater. He first puts up a red glass and a colorless glass with a shadow-casting rod in front of them, and then he covers the colorless glass with sheets of tissue paper until the contrast green reaches a maximum. He then draws out the red glass and pushes it back gradually; as he does so, the contrast green grows stronger and stronger. It seems to us that the reasoning here is not quite conclusive. It is merely shown that the degree of grayness which suits a certain degree of redness best, is in turn best suited by that particular degree of redness. In other words, choose, out of all possible graynesses, the one that gives the best effect of contrast with a certain redness, then no other redness will give so good an effect of contrast with that particular grayness. It is not shown that a more saturated green would not be produced with a different redness and a different grayness (though experiments which he has not described may have enabled him to infer

this); one cannot help being on the lookout for that "favorable difference," independent of absolute color or brightness, which Neiglick has shown the existence of in brightness contrast.

C. L. F.

Ueber die Ursachen der Erythropsie. DOBROWOLSKY. Archiv für Ophthalmologie, Vol. 33, 2, p. 213.

After the performance of certain operations upon the eye, the patient sometimes sees everything violet, rose-colored or reddish, or in some cases of a bright red, even a blood-red, color. Occasionally darker objects look green. The affection lasts sometimes for a few minutes, sometimes for days; since its first accurate description in 1881, over thirty cases have been noted. Dobrowolsky has confirmed by experiment the hypothesis that it is due to an after-image of some bright object, as the edge of the sun or a bright cloud. He widened the pupil of one eye by atropin, and then found that after looking at a bright cloud near the sun, or the edge of the sun itself, all white objects in a room looked violet. This violet color lasted sometimes for a quarter of an hour, and it was succeeded by a state of excitation of the retina, during which, for an hour, all objects looked yellow, orange, or carmine-red. With the other eye, the pupil of which was kept narrow for purposes of comparison, a sharp, distinct after-image of the sun was obtained which was bright blue in the middle and violet on the edge. The widening of the pupil is then, under ordinary circumstances, a necessary condition for the production of the phenomenon. Violet-vision would be a better name for it than red-vision; it might be expected to occur more frequently were it not that the eyes are usually protected from a bright light when they are in a condition favorable to bringing it on.

- (1) *Ueber die Zeit der Erkennung und Benennung von Schriftzeichen, Bildern und Farben.* JAMES McKEEN CATTELL. Wundt's Philos. Studien, II (1885), pp. 635-650. Also in abstract by the author, Mind, XI (1886), pp. 63-65.
- (2) *Ueber die Trägheit der Netzhaut und des Sehcentrums.* JAMES McKEEN CATTELL. Wundt's Philos. Studien, III (1885), 1, pp. 94-127. Also, slightly abbreviated, Brain, Vol. VIII, pp. 295-312.
- (3) *The Influence of the Intensity of the Stimulus on the Length of the Reaction Time.* JAMES McKEEN CATTELL. Brain, Vol. VIII, p. 512.

(1) In the time measurements of which this study consists, complicated apparatus was avoided. For the first series, a kymograph drum was covered with white paper, on which the letters, pictures, or colored spots to be shown, were pasted. Between the drum and the subject was a screen, and in it a horizontal slit of adjustable length, through which the letters, etc., were to be viewed. The letters were so spaced that when the slit was 1 cm. long, the second letter was brought into view as the first disappeared; when the slit was 2 cm. long, two letters were constantly in the field, and so on. The following are the average times from nine subjects:

Length of slit in mm..... 1 2.5 5 10 20 30 40 50 60
Time in thousandths of a sec., 499 356 292 248 225 209 202 198 198

From this it appears that about 0.25 s. was required for each letter when the slit was 10 mm. long and one letter at a time could be